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PERFORMANCE CHARACTERISTICS OF AUTOMOTIVE ENGINES IN THE UNITED STATES

First Series - Report No. 19

1975 Ford Windsor 351 CID (5.7 Liters), 2V

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K. R. Stamper

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16. Abstract

Experimental data were obtained in dynamometer tests of a 1975 Ford 351 CID, 2V, Windsor engine to determine fuel consumption and emissions (hydrocarbon, carbon monoxide, oxides of nitrogen) at steady-state engine-operating modes. The objective of the program is to obtain engine performance data for estimating emissions and fuel economy for varied engine service and duty. The intent of the work is to provide basic engine characteristic data required as input for engineering calculations involving ground transportation.

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PREFACE

This report, prepared by the U.S. Department of Energy, Bartlesville Energy Research Center, for the U.S. Department of Transportation, Transportation Systems Center, Energy Technology Branch, Cambridge MA, presents results of experimental work to obtain information on performance characteristics of an engine used in automobiles sold in the U.S. The engine used in this work is one of a series of 23 engines to be tested in the current program. This is the nineteenth of the reports to be published covering work with those engines.

This project is funded by the National Highway Traffic Safety Administration, Office of Research and Development, Office of Passenger Vehicle Research, Technology Assessment Division.

Ralph G. Colello and James A. Kidd, Jr., of the U.S. Department of Transportation, Transportation Systems Center, are the technical monitors.

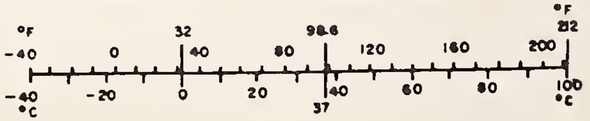
METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
in	inches	2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
		AREA		
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
		MASS (weight)		
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
		VOLUME		
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
		AREA		
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
		MASS (weight)		
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
		VOLUME		
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
		TEMPERATURE (exact)		
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



1. INTRODUCTION

The data acquired from tests of a 1975 Ford 351 CID, 2V, Windsor engine are presented in this report. This engine is used by Ford in the full-sized vehicles (Torino, Elite and Granada). The test results are sufficient to establish steady-state maps for fuel consumption and emissions (carbon monoxide, unburned hydrocarbon and oxides of nitrogen) over the entire operating range of the engine.

The objective of the report is to obtain engine performance data for estimating emissions and fuel economy for varied engine service and duty. The intent of the work is to provide basic engine characteristic data required as input for engineering calculations involving ground transportation.

2. ENGINE TEST REPORT

General engine specifications for the Ford 351 CID, 2V, Windsor engine are listed in table 1. The engine break-in (table 2) and tests were run using a single batch of unleaded regular grade gasoline; an analysis of the fuel is given in table 3.

The engine tests were run with a new mean-tolerance engine mounted on a test stand and coupled to an eddy-current dynamometer. Engine cooling was provided through the use of a cooling tower; the radiator and fan were not included in the test set-up. The engine was equipped with an alternator but it was not wired into the engine's electrical system. The emission control systems included exhaust-gas-recirculation (EGR), air injection, oxidation catalyst, and high energy ignition.

The engine was operated at various speeds and loads designed to approximate road load conditions over a 40-hour peirod for break-in. The engine tests began on 6 March and ended on 7 May, 1976, giving a total engine operating time of approximately 185 hours. The engine was tested while operating at the following steady-state modes:

Speeds: 1,200; 1,500; 2,000; 2,400; 2,800; 3,300; 3,800 rpm

Loads: 0, 10, 25, 40, 60, 75, 90, 100 pct of full load (repeated at 0, 10, 25, 60, 90 pct of full load for each speed except 1,200 rpm)

Idle speed loads: 0, 1, 2 bhp (repeated at each condition for one speed)

Total number of test modes..............	67
Repeats..................................	38
Total number of tests..............	105 .

The following data were recorded for each test point:

Test number
Date
Barometric pressure, mm Hg
Dewpoint, °F
Inlet air temperature, °F
Speed, rpm
Torque, lb-ft -- BLH strain gage load cell; Daytronics indicator
Fuel rate, lb/hr -- Fluidyne positive displacement fuel flowmeter
Ignition timing, °BTC
Manifold vacuum, in. Hg
Throttle angle, deg.

CO, pct -- Beckman NDIR
CO_2, pct -- Beckman NDIR
O_2, pct -- Beckman polarographic detector
HC, ppmC -- Custom-built heated flame ionization detector
NO_x, ppm -- Thermo-Electron chemiluminescent detector
Oil temperature, °F
Oil pressure, psig
Coolant temperature, °F
Exhaust temperature, °F
Exhaust pressure, in. H_2O
Intake manifold temperature, °F.

The computed data include absolute humidity (grains/lb dry air), power (bhp), air-fuel ratio (includes air injection), and emission rates of carbon monoxide (CO), unburned hydrocarbons (HC), and oxides of nitrogen (NO_x) in grams/hour. The following equations were applied in the computations:

$$W = \exp\left[12.02\left(\frac{D - 1.4}{D + 212}\right)\right],$$

$$H = \frac{4348\ W}{B - W},$$

$$P = \left(\frac{N \times T}{5252}\right)\left(\frac{736.6}{B - W}\right)\left(\frac{t + 460}{545}\right)^{0.5},$$

$$A/F = 4.895\ \frac{(CO) + 2(CO_2) + 2(O_2) + \left(\frac{NO_x}{10^4}\right) + 3.148\ (CO_2)\left(\frac{CO + CO_2}{CO + 3CO_2}\right)}{(CO) + (CO_2) + \left(\frac{NO_x}{10^4}\right)\left[1 + 0.03148(CO_2)\left(\frac{CO + CO_2}{CO + 3CO_2}\right)\right]}.$$

The equation for A/F is based on:

Fuel = $CH_{2.099}$,

Water-gas-shift equilibrium constant $= \frac{(CO)\ (H_2O)}{(CO_2)\ (H_2)} = 3$,

HC was determined on a raw exhaust basis, all other species measured on a dry basis.

$$\text{Mass CO} = \left(\frac{M_{ex}}{C_w}\right)\left(\frac{CO}{100}\right)\left(\frac{MW_{co}}{MW_{ex}}\right)453.59237,$$

where MW_{co} = molecular weight of CO(=28.01115),

MW_{ex} = molecular weight of exhaust gas (=28.967),

$$C_W = \text{correction for water removal} = 1 + \frac{\left(\frac{x}{2}\right)\left(CO+CO_2\right)-H_2}{100}\ .$$

$$\text{Mass HC} = 0.0002207\ (F)\ (A/F + 1)\ (HC),$$

$$\text{Mass NO}_x = 0.0007201\ (F)\ (A/F + 1)\ (NO_x)\left[\frac{1}{1 + 0.03148(CO_2)\left(\frac{CO + CO_2}{CO + 3CO_2}\right)}\right]\left(K_H\right),$$

where K_H is the humidity correction factor (dimensionless):

$$K_H = \frac{1}{1 - 0.0047\ (H - 75)}\ ,$$

where A/F = air-fuel ratio

B = barometric pressure, mm Hg

CO = carbon monoxide concentration, vol pct

CO_2 = carbon dioxide concentration, vol pct

D = intake air dew point, °F

F = fuel rate, lb/hr

H = humidity, grains H_2O/lb dry air

HC = unburned hydrocarbon concentration, ppmC, vol

K_H = humidity correction factor

N = engine speed, rpm

NO_x = nitrogen oxides concentration, ppm vol

O_2 = oxygen concentration, vol pct

P = corrected power, brake horespower

t = intake air temperature, °F

T = Torque, ft-lb

W = water vapor pressure, mm Hg.

3. DISCUSSION OF TEST RESULTS

The maximum power and torque output of the engine show values similar, but slightly lower than those quoted in table 1. The peak values of corrected brake horsepower and corrected torque occur near the engine speeds noted in table 1; this can be seen in plot of the parameters taken at wide-open-throttle (WOT) conditions (figure 1). The minimum brake specific fuel consumption (bsfc) for the engine operating at WOT was found at the same engine speed as the peak torque output. The lowest values of bsfc are shown to occur near 75 pct of full load for most engine speeds. This point is brought out in figure 2 as the region in which the fuel consumption rate deviates from the nearly linear relationship with power. The air-fuel ratio values given for each speed load condition do not reflect the actual stoichiometry of the combustion chamber (figure 3). This is due to the operation of the air injection system supplying oxygen rich air to the exhaust gases prior to treatment from the oxidation catalyst. The effect of these emission control systems can be seen in the relatively low emission rates of CO and HC (figures 4 and 5) except near WOT. Emissions of NO_x reach a maximum in a range of 60 to 90 pct of full load for most engine speeds (figure 6).

The repeatability of engine performance and emission and fuel consumption rates is satisfactory for the purposes of this test.

4. CONCLUSIONS

The purpose of the experimental work reported here is to establish data for this engine. Those data are presented in the tables accompanying this report.

TABLE 1. GENERAL ENGINE SPECIFICATIONS

Displacement	351 cu. in.
Maximum horsepower	175 bhp @ 3,800 rpm
Maximum torque	284 ft-lb @ 2,200 rpm
Bore and stroke	4.00 in. x 3.50 in.
Configuration	90° V 8 cylinders
Compression ratio	8.0
Firing order	1-3-7-2-6-5-4-8
Ignition timing at idle	6° BTC @ 500 rpm
Spark plug gap	0.045 in.
Block material	cast iron
Head material	cast iron
Number of crankshaft main bearings	5
Number of compression rings/piston	2
Number of oil rings/piston	1
Cam drive	chain
Valve port size:	
Intake	1.78 in.
Exhaust	1.45 in.
Valve timing:	
Intake, opens	15° BTC
Intake, closes	65° ABC
Exhaust, opens	68° BBC
Exhaust, closes	26° ATC
Valve lift:	
Intake	0.419 in.
Exhaust	0.448 in.
Air-injection system:	
Pump type	impeller
Air delivery point	exhaust manifold
Exhaust-gas recirculation:	
Valve type	tapered stem
Control signal	2V and manifold vacuum
Point of discharge	EGR spacer
Crankcase emission control:	
Control method	positive crankcase ventilation
Point of discharge	air cleaner
Distributor specifications:	
Centrifugal advance, begins	1° @ 550 rpm
Centrifugal advance, intermediate	4-1/2° @ 1,000 rpm
Centrifugal advance, full	16-1/2° @ 2,500 rpm
Vacuum advance, begins	4-1/2 in. Hg
Vacuum advance, maximum	13-1/4° @ 19 in. Hg

TABLE 2. ENGINE BREAK-IN SCHEDULE

Simulated Vehicle Speed, mph	Engine Speed, rpm	Manifold Vacuum, in. Hg	Fraction of Time in Mode
0	800	14.5	1/10
20	900	13.8	"
30	1,350	13.8	"
40	1,750	12.5	"
50	2,200	13.0	"
60	2,650	12.4	"
25	1,150	13.5	"
35	1,550	13.4	"
45	1,900	12.8	"
55	2,450	12.8	"

Total mileage per cycle = 90 miles.
Total mileage for 40-hour break-in period = 1,440 miles.

TABLE 3. FUEL SPECIFICATIONS

Fuel No	7602
Research octane No	91.5
Motor octane No	83.8
Reid vapor pressure, psig	11.9
Distillation, °F:	
10 pct	134
50 pct	214
95 pct	388
100 pct	418
API gravity, deg	67.0
Specific gravity	0.7126
FIA analysis, pct:	
Aromatics	11
Olefins	16
Paraffins	73
Sulfur, pct	0.024
Lead, g/gal	Trace
Hydrogen/carbon atomic ratio	2.09

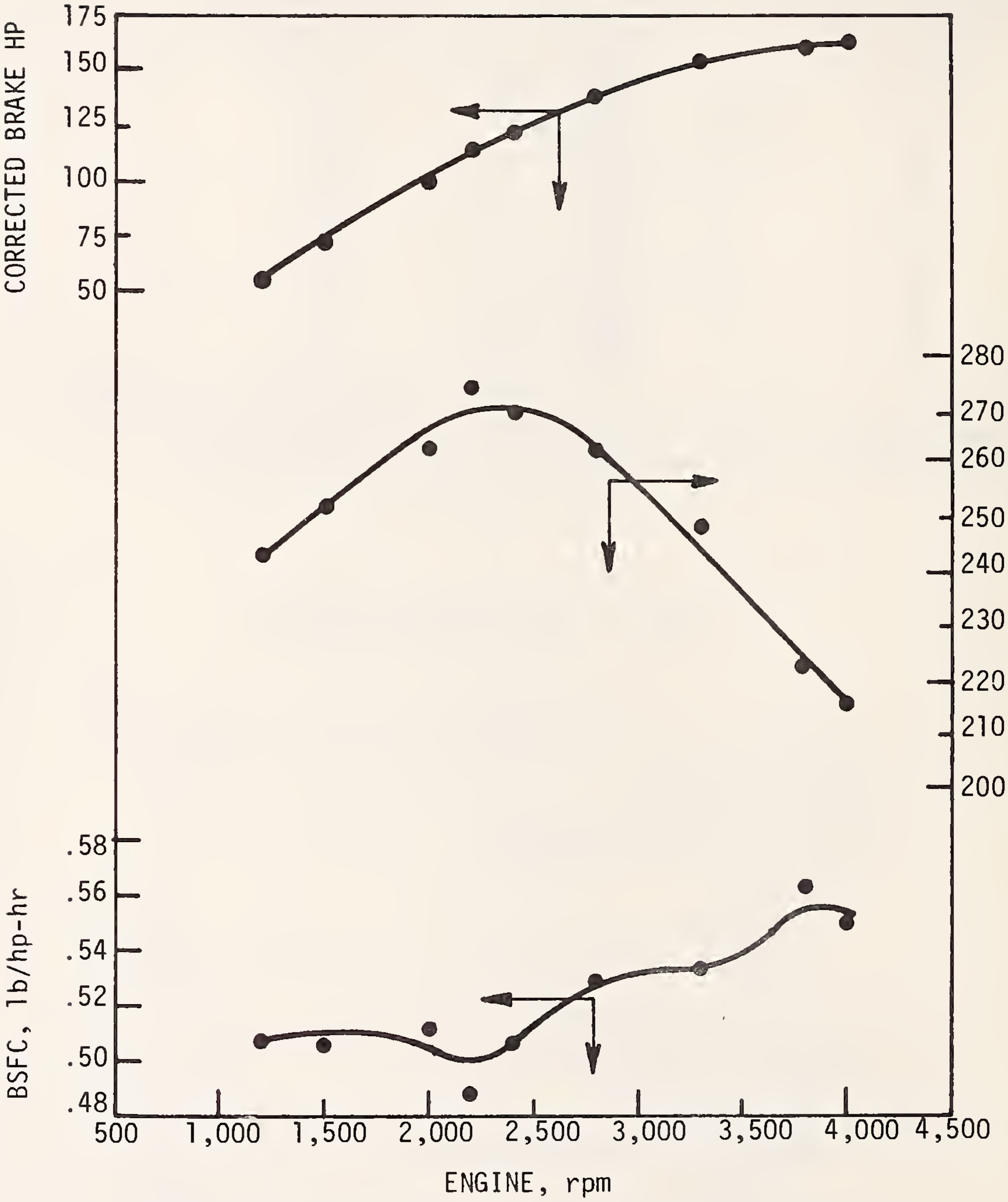


FIGURE 1. Brake Specific Fuel Consumption, Torque, and Brake Horsepower versus Engine rpm at Wide-Open-Throttle--351-CID Ford Engine.

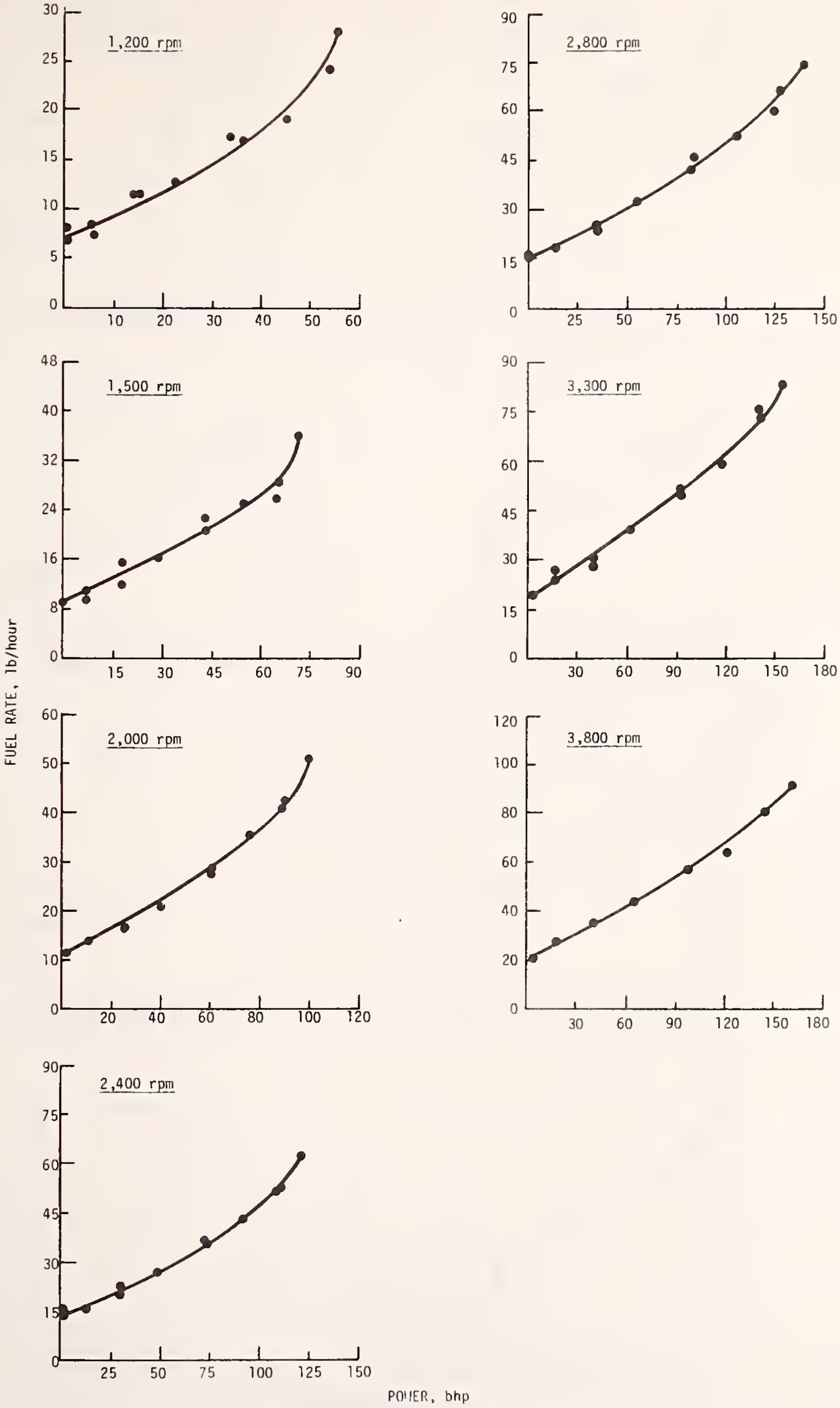


FIGURE 2. Fuel Rate versus Power at Various Speed and Load Conditions--351-CID Ford Engine.

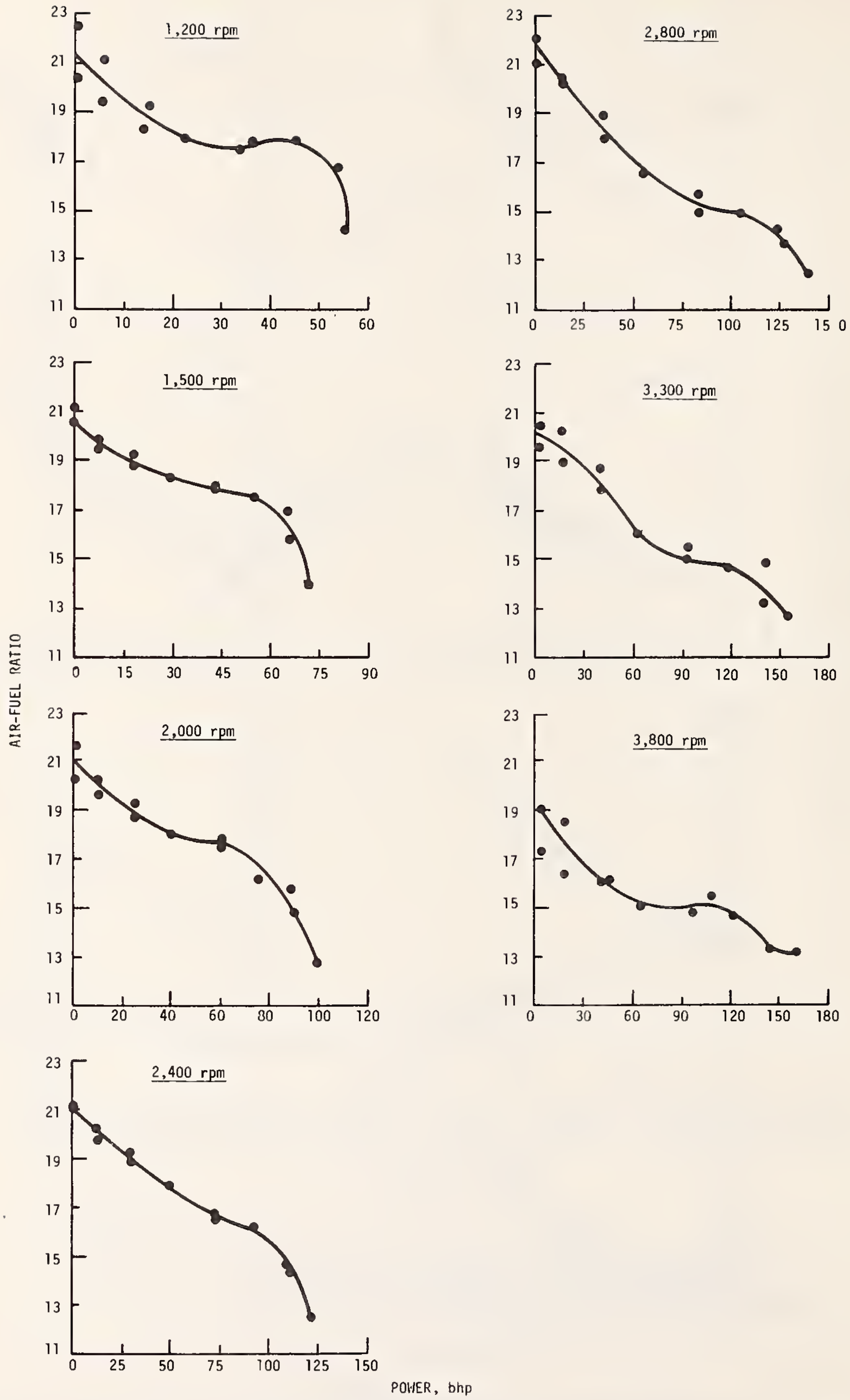


FIGURE 3. Air/Fuel Ratio versus Power at Various Speed and Load Conditions--351-CID Ford Engine.

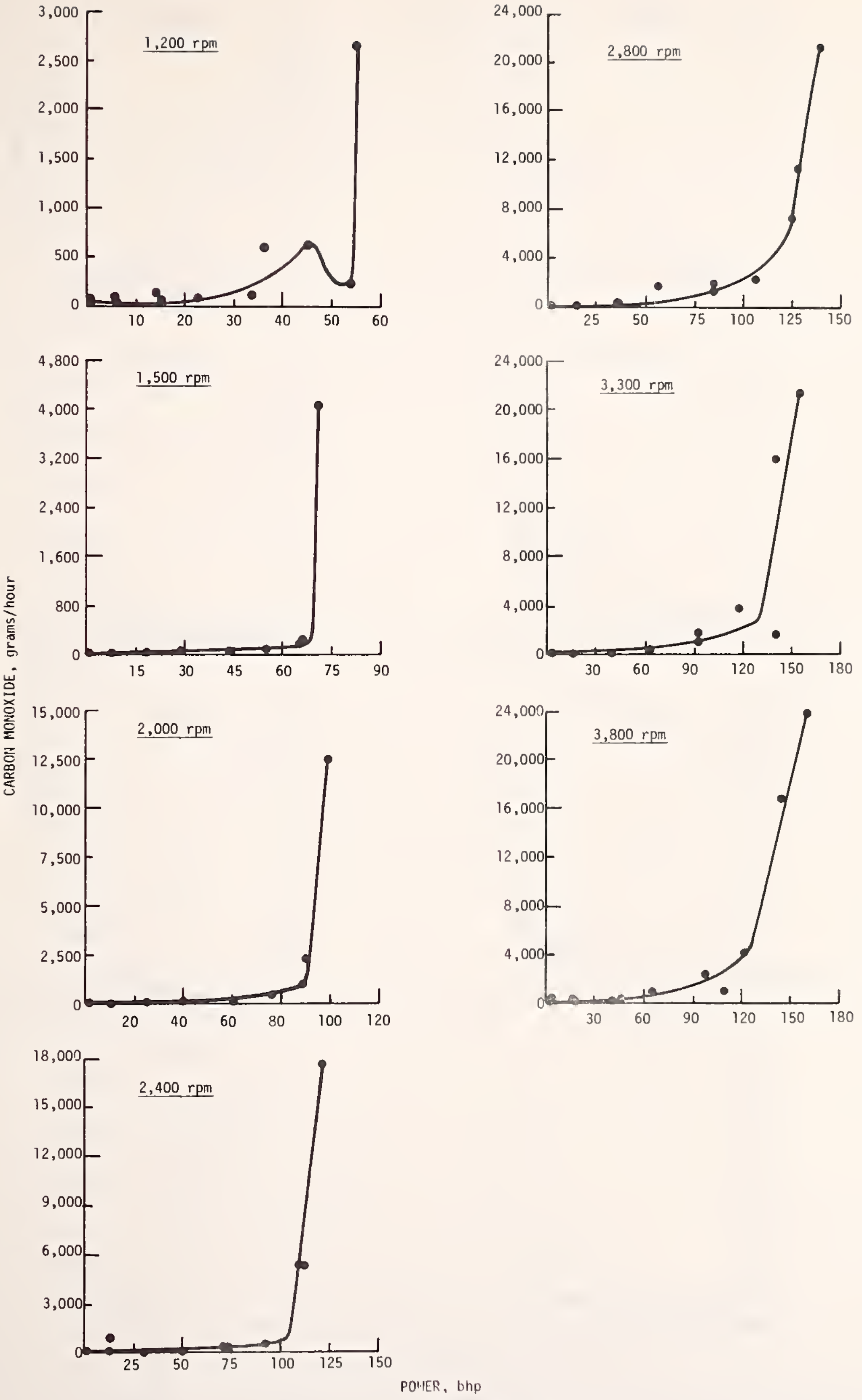


FIGURE 4. Carbon Monoxide Emissions versus Power at Various Speed and Load Conditions--351-CID Ford Engine.

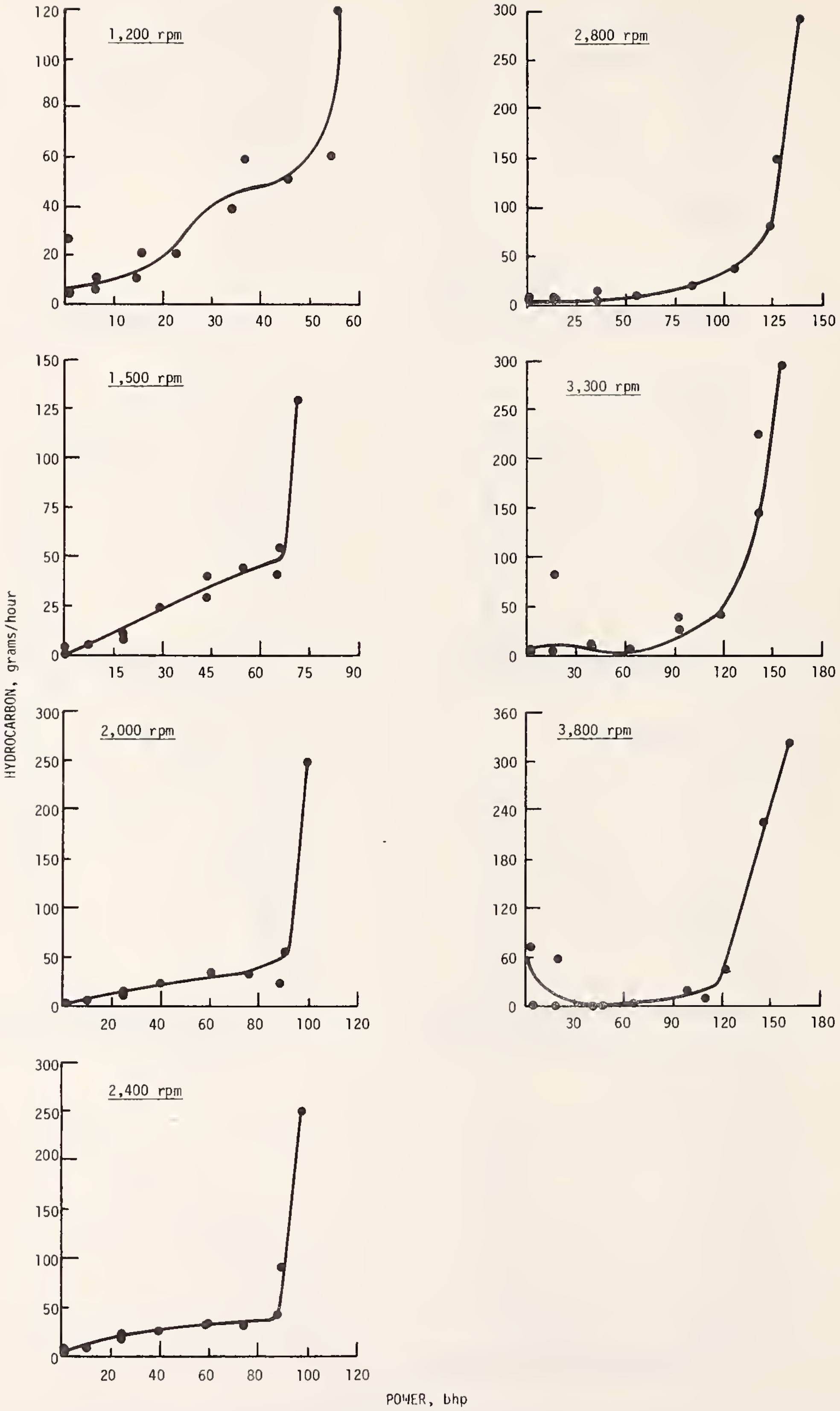


FIGURE 5. Hydrocarbon Emissions versus Power at Various Speed and Load Conditions--351-CID Ford Engine.

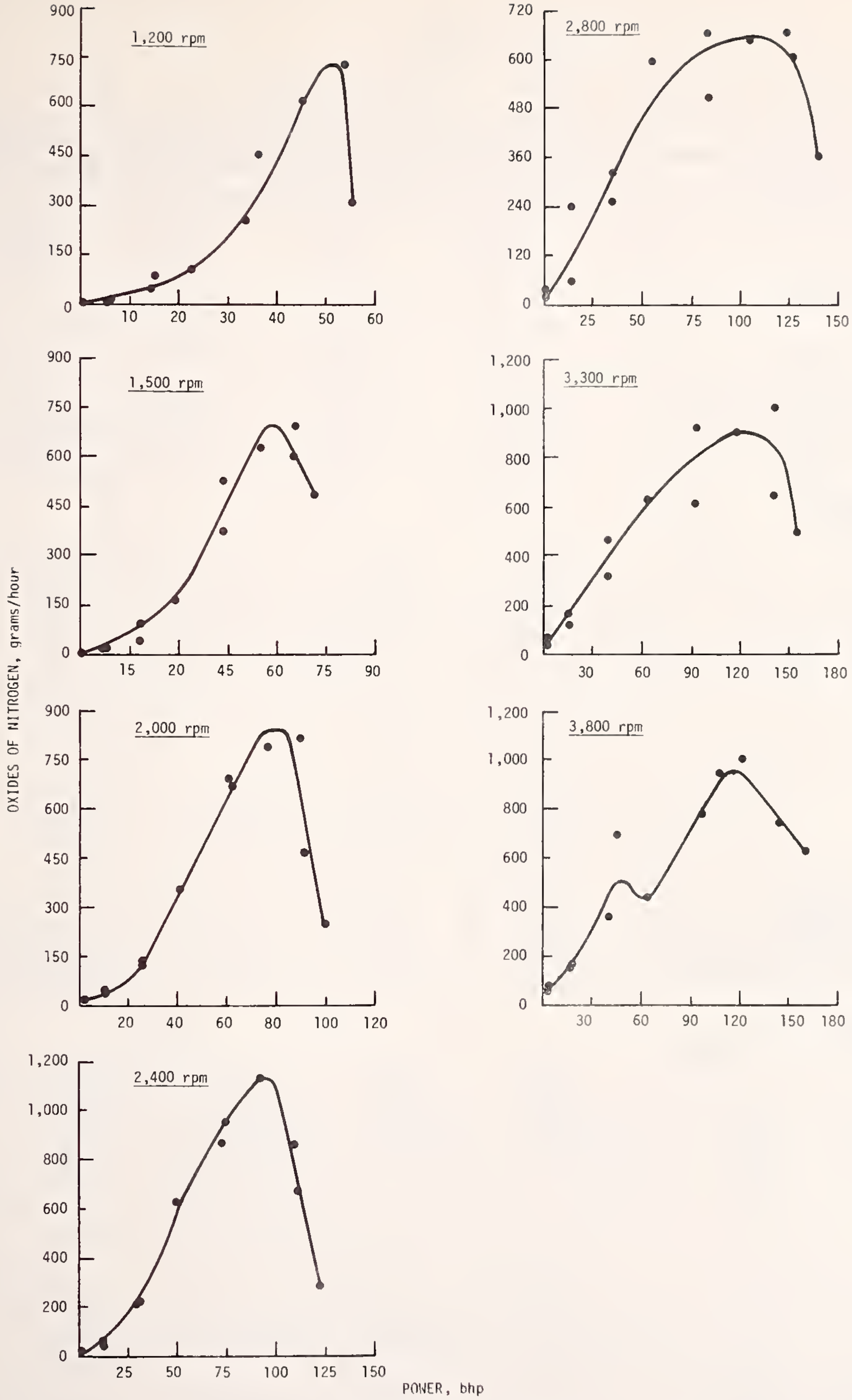


FIGURE 6. Oxides of Nitrogen versus Power at Various Speed and Load Conditions--351-CID Ford Engine.

Engine...................... Ford 351-CID
Fuel........................ 7602

Test Number................. Test Date...................	1 3/ 6/76	2 3/ 6/76	3 3/ 6/76	4 3/ 6/76	5 3/ 6/76
Barometer, mm Hg............	749.2	749.2	749.2	749.2	749.2
Humidity, grains/lb.........	29	29	29	29	29
Temperature, F..............	55	66	64	64	66
Engine speed, rpm...........	700	700	700	750	750
Torque, lb-ft...............	1.0	8.0	15.2	1.0	8.2
Power, bhp*.................	.1	1.0	2.0	.1	1.1
Fuel rate, lb/hr............	4.7	5.2	5.3	5.2	5.6
Ignition timing, deg BTC....	6.0	6.0	6.0	6.0	6.0
Manifold vacuum, in Hg......	18.0	17.7	17.0	18.0	18.0
Throttle angle, deg.........	0.0	1.0	1.0	0.0	1.0
Intake man. temp., F........	134	137	136	137	137
Before Catalyst					
Concentrations, dry basis:					
CO, %...................	.2533	.1511	.1420	.1650	.1721
CO2, %..................	9.85	9.99	10.14	9.99	10.12
O2, %...................	6.75	6.50	6.25	6.50	6.25
HC, ppmC................	801	696	675	580	564
NOx, ppm................	53	45	64	52	60
Air-fuel ratio..............	21.12	20.95	20.64	20.95	20.63
Emission rates, g/hr:					
CO......................	104.1	68.9	64.4	75.2	82.1
HC......................	16.6	16.0	15.4	13.3	13.5
NOx**...................	2.9	2.7	3.9	3.2	3.9
Oil temperature, F..........	191	185	184	184	185
Oil pressure, psi...........	40	40	40	44	45
Coolant temperature, F......	186	176	174	187	186
Exhaust temperature, F......	824	814	807	824	825
Exhaust pressure, in H2O....	5.5	5.5	5.5	5.5	5.5
After Catalyst					
Concentrations, dry basis:					
CO, %...................	.1080	.0844	.0748	.0748	.0940
CO2, %..................	9.85	9.89	9.99	9.84	10.09
O2, %...................	6.90	6.75	6.55	6.75	6.35
HC, ppmC................	607	55	602	452	431
NOx, ppm................	54	57	68	55	63
Air-fuel ratio..............	21.50	21.47	21.11	21.43	20.87
Emission rates, g/hr:					
CO......................	45.2	39.5	34.7	34.9	45.4
HC......................	12.8	1.3	14.1	10.6	10.5
NOx**...................	3.0	3.6	4.2	3.5	4.1
Exhaust temperature, F......	602	587	584	591	597
Exhaust pressure, in H2O....	2.0	2.0	2.0	2.0	2.0

* Corrected - SAE J816b
** Corrected for humidity.

Engine...................... Ford 351-CID
Fuel........................ 7602

Test Number.................	6	7	8	9	10
Test Date...................	3/ 6/76	3/ 6/76	3/ 6/76	3/ 6/76	3/ 6/76
Barometer, mm Hg............	749.2	749.2	749.2	749.2	749.2
Humidity, grains/lb.........	29	29	29	29	29
Temperature, F..............	67	67	67	67	74
Engine speed, rpm...........	750	800	800	800	1200
Torque, lb-ft...............	14.8	1.0	8.2	15.0	247.0
Power, bhp*.................	2.1	.1	1.2	2.2	55.3
Fuel rate, lb/hr............	5.7	5.4	5.8	6.1	28.0
Ignition timing, deg BTC....	6.0	6.0	6.0	6.0	9.0
Manifold vacuum, in Hg......	17.0	18.0	17.8	17.5	.5
Throttle angle, deg.........	1.0	0.0	1.2	1.5	80.0
Intake man. temp., F........	138	140	141	141	80
Before Catalyst					
Concentrations, dry basis:					
CO, %...................	.1665	.1890	.2205	.1836	2.4700
CO2, %..................	10.26	10.19	10.27	10.39	12.50
O2, %...................	6.00	6.10	5.95	5.80	.38
HC, ppmC................	598	437	477	532	1690
NOx, ppm................	70	63	65	80	1450
Air-fuel ratio..............	20.32	20.46	20.23	20.07	13.92
Emission rates, g/hr:					
CO......................	79.4	96.3	108.0	92.9	3304.9
HC......................	14.4	11.2	11.7	13.6	113.8
NOx**...................	4.5	4.3	4.3	5.4	262.0
Oil temperature, F..........	186	186	187	187	202
Oil pressure, psi...........	42	46	45	45	45
Coolant temperature, F......	187	177	187	187	178
Exhaust temperature, F......	827	847	855	856	1137
Exhaust pressure, in H2O....	5.5	5.5	5.5	5.5	24.9
After Catalyst					
Concentrations, dry basis:					
CO, %...................	.0940	.0940	.1036	.0964	1.9300
CO2, %..................	10.11	10.06	10.09	10.19	12.62
O2, %...................	6.25	6.35	6.25	6.13	.55
HC, ppmC................	492	354	365	393	1716
NOx, ppm................	74	66	69	80	1675
Air-fuel ratio..............	20.75	20.90	20.77	20.61	14.26
Emission rates, g/hr:					
CO......................	45.8	48.9	52.2	50.2	2647.1
HC......................	12.1	9.3	9.2	10.3	118.4
NOx**...................	4.8	4.6	4.7	5.6	310.3
Exhaust temperature, F......	606	616	631	634	953
Exhaust pressure, in H2O....	2.0	2.0	2.0	2.0	15.0

* Corrected - SAE J816b
** Corrected for humidity.

Engine........................ Ford 351-CID
Fuel.......................... 7602

Test Number..................	11	12	13	14	15
Test Date....................	3/30/76	3/30/76	3/10/76	3/10/76	3/10/76
Barometer, mm Hg.............	747.0	747.0	745.1	745.1	745.1
Humidity, grains/lb..........	56	56	46	46	46
Temperature, F...............	73	79	86	86	86
Engine speed, rpm............	1200	1200	1200	1200	1200
Torque, lb-ft................	230.0	190.0	148.0	99.0	62.0
Power, bhp*..................	53.9	45.3	33.8	22.6	14.2
Fuel rate, lb/hr.............	24.2	19.2	17.4	12.9	11.6
Ignition timing, deg BTC.....	10.0	13.0	17.0	10.0	9.0
Manifold vacuum, in Hg.......	2.5	5.5	10.0	12.5	15.5
Throttle angle, deg..........	28.2	18.5	8.5	4.5	3.0
Intake man. temp., F.........	116	127	142	147	145
Before Catalyst					
Concentrations, dry basis:					
CO, %..................	.2327	.0470	.1557	.1890	.2380
CO2, %.................	12.75	12.01	12.37	12.01	11.78
O2, %..................	2.20	3.50	3.15	3.80	4.13
HC, ppmC...............	964	911	847	574	298
NOx, ppm...............	3000	2900	1388	750	340
Air-fuel ratio...............	16.44	17.71	17.22	17.80	18.11
Emission rates, g/hr:					
CO.....................	379.9	65.8	190.9	178.2	205.5
HC.....................	79.2	64.2	52.3	27.2	12.9
NOx**..................	738.7	612.7	246.3	102.3	42.5
Oil temperature, F...........	202	226	207	209	207
Oil pressure, psi............	53	45	54	50	55
Coolant temperature, F.......	178	194	185	187	184
Exhaust temperature, F.......	1147	1142	1116	1061	1072
Exhaust pressure, in H2O.....	30.5	24.9	19.4	13.9	11.1
After Catalyst					
Concentrations, dry basis:					
CO, %..................	.1420	.4377	.0892	.0940	.1511
CO2, %.................	12.62	11.66	12.33	12.01	11.78
O2, %..................	2.50	3.90	3.33	3.80	4.25
HC, ppmC...............	713	708	621	422	236
NOx, ppm...............	2900	2900	1425	770	380
Air-fuel ratio...............	16.77	17.84	17.45	17.90	18.29
Emission rates, g/hr:					
CO.....................	236.6	617.8	110.9	89.1	131.8
HC.....................	59.8	50.3	38.8	20.1	10.4
NOx**..................	728.9	617.4	256.2	105.6	48.0
Exhaust temperature, F.......	971	961	931	861	870
Exhaust pressure, in H2O.....	21.0	15.0	12.0	7.0	5.0

* Corrected - SAE J816b
** Corrected for humidity.

Engine........................ Ford 351-CID
Fuel.......................... 7602

Test Number.................	16	17	18	19	20
Test Date...................	3/10/76	3/10/76	3/10/76	3/10/76	3/10/76
Barometer, mm Hg............	745.1	745.1	745.1	745.1	745.1
Humidity, grains/lb.........	46	46	46	46	46
Temperature, F..............	86	82	61	87	88
Engine speed, rpm...........	1200	1200	1500	1500	1500
Torque, lb-ft...............	25.0	3.0	257.0	231.0	193.0
Power, bhp*.................	5.7	.7	71.7	66.0	55.2
Fuel rate, lb/hr............	8.5	8.2	36.2	28.6	25.1
Ignition timing, deg BTC....	10.0	10.0	11.5	13.0	14.5
Manifold vacuum, in Hg......	18.0	20.0	.5	3.5	5.0
Throttle angle, deg.........	1.5	1.5	80.0	37.0	24.0
Intake man. temp., F........	145	145	104	127	134
Before Catalyst					
Concentrations, dry basis:					
CO, %.......................	.2635	.1650	2.3200	.0772	.0844
CO2, %......................	11.21	10.64	12.62	13.32	12.50
O2, %.......................	4.98	5.75	.30	1.35	2.65
HC, ppmC....................	207	121	1328	820	667
NOx, ppm....................	116	72	1550	2900	2500
Air-fuel ratio..............	18.98	20.00	13.67	15.86	16.93
Emission rates, g/hr:					
CO..........................	174.6	111.3	4776.4	143.0	147.1
HC..........................	6.9	4.1	135.3	76.5	58.5
NOx**.......................	11.1	7.0	461.7	777.4	630.6
Oil temperature, F..........	206	204	211	231	231
Oil pressure, psi...........	55	56	55	40	52
Coolant temperature, F......	185	187	194	189	192
Exhaust temperature, F......	1030	1071	1257	1271	1260
Exhaust pressure, in H2O....	9.7	8.3	58.2	29.1	38.8
After Catalyst					
Concentrations, dry basis:					
CO, %.......................	.1325	.0916	1.9300	.1229	.0447
CO2, %......................	11.00	10.53	12.75	13.53	12.13
O2, %.......................	5.25	6.00	.45	1.25	3.20
HC, ppmC....................	178	129	1242	594	484
NOx, ppm....................	123	78	1600	2600	2400
Air-fuel ratio..............	19.42	20.36	13.94	15.76	17.48
Emission rates, g/hr:					
CO..........................	90.0	62.9	4051.3	225.9	80.6
HC..........................	6.1	4.5	129.1	54.9	44.0
NOx**.......................	12.1	7.8	486.0	691.5	626.3
Exhaust temperature, F......	799	817	1100	1099	1078
Exhaust pressure, in H2O....	3.0	3.0	42.0	20.0	27.0

* Corrected - SAE J816b
** Corrected for humidity.

Engine........................ Ford 351-CID
Fuel.......................... 7602

Test Number..................	21	22	23	24	25
Test Date....................	3/10/76	3/10/76	3/10/76	3/10/76	3/10/76
Barometer, mm Hg............	745.1	745.1	745.1	745.1	745.1
Humidity, grains/lb.........	46	46	46	46	46
Temperature, F..............	81	77	84	87	87
Engine speed, rpm...........	1500	1500	1500	1500	1500
Torque, lb-ft...............	154.0	103.0	64.0	26.0	.6
Power, bhp*.................	43.8	29.2	18.2	7.4	.2
Fuel rate, lb/hr............	22.7	16.3	15.5	10.9	9.0
Ignition timing, deg BTC....	21.5	18.5	18.5	12.2	11.0
Manifold vacuum, in Hg......	8.3	12.5	16.0	18.8	20.5
Throttle angle, deg.........	18.0	12.0	10.5	7.0	5.0
Intake man. temp., F........	145	131	149	151	152
Before Catalyst					
Concentrations, dry basis:					
CO, %.....................	.0677	.1036	.1229	.1373	.1229
CO2, %....................	12.01	11.66	11.55	11.34	10.52
O2, %.....................	3.25	4.34	4.53	4.75	5.85
HC, ppmC..................	675	572	336	153	104
NOx, ppm..................	2250	935	545	180	85
Air-fuel ratio..............	17.50	18.41	18.61	18.86	20.20
Emission rates, g/hr:					
CO........................	110.9	128.1	146.2	116.8	92.7
HC........................	55.6	35.6	20.1	6.6	4.0
NOx**.....................	533.1	167.3	93.8	22.2	9.3
Oil temperature, F..........	228	189	212	211	207
Oil pressure, psi...........	54	58	55	57	57
Coolant temperature, F......	190	184	189	190	187
Exhaust temperature, F......	1196	1070	1111	1127	1127
Exhaust pressure, in H20....	33.3	16.6	16.6	11.1	11.1
After Catalyst					
Concentrations, dry basis:					
CO, %.....................	.0401	.0653	.0677	.0796	.0653
CO2, %....................	11.89	11.78	11.53	11.00	10.39
O2, %.....................	3.55	4.15	4.64	5.25	6.13
HC, ppmC..................	478	393	185	120	95
NOx, ppm..................	2200	960	550	185	93
Air-fuel ratio..............	17.82	18.28	18.78	19.49	20.59
Emission rates, g/hr:					
CO........................	66.9	80.1	81.3	70.1	50.3
HC........................	40.1	24.3	11.2	5.3	3.7
NOx**.....................	531.0	170.4	95.5	23.6	10.4
Exhaust temperature, F......	1020	904	930	897	866
Exhaust pressure, in H20....	22.0	10.2	10.0	6.0	5.0

* Corrected - SAE J816b
** Corrected for humidity.

Engine...................... Ford 351-CID
Fuel........................ 7602

Test Number................. Test Date...................	26 3/ 8/76	27 3/ 8/76	28 3/ 8/76	29 3/ 8/76	30 3/ 8/76
Barometer, mm Hg............	743.0	743.0	743.0	743.0	743.0
Humidity, grains/lb.........	56	56	56	56	56
Temperature, F..............	86	94	97	92	87
Engine speed, rpm...........	2000	2000	2000	2000	2000
Torque, lb-ft...............	260.0	234.0	195.0	156.0	104.0
Power, bhp*.................	99.5	90.2	75.4	60.0	39.8
Fuel rate, lb/hr............	50.9	42.4	35.4	27.6	21.0
Ignition timing, deg BTC....	16.0	17.0	17.5	25.0	30.0
Manifold vacuum, in Hg......	.5	2.4	5.0	8.5	13.0
Throttle angle, deg.........	80.0	35.5	26.0	19.5	11.0
Intake man. temp., F........	111	126	135	144	152
Before Catalyst					
Concentrations, dry basis:					
CO, %.................	5.5000	1.7700	.3910	.0964	.1180
CO2, %................	10.73	13.00	13.26	12.50	11.89
O2, %.................	.05	.67	1.45	2.73	3.75
HC, ppmC..............	1802	975	513	537	422
NOx, ppm..............	430	1538	2188	2325	1375
Air-fuel ratio..............	12.40	14.49	15.77	16.99	17.89
Emission rates, g/hr:					
CO....................	14374.6	4441.0	892.4	185.7	182.5
HC....................	237.0	123.1	59.0	52.1	32.8
NOx**.................	169.6	582.3	753.5	675.7	321.0
Oil temperature, F..........	237	247	247	241	234
Oil pressure, psi...........	55	53	53	54	55
Coolant temperature, F......	187	187	187	187	187
Exhaust temperature, F......	1326	1421	1404	1294	1196
Exhaust pressure, in H2O....	83.1	85.9	72.1	52.7	30.5
After Catalyst					
Concentrations, dry basis:					
CO, %.................	4.6200	.8803	.1603	.0493	.0653
CO2, %................	11.06	13.80	13.23	12.25	11.89
O2, %.................	.04	.37	1.75	3.15	3.82
HC, ppmC..............	1829	431	273	350	292
NOx, ppm..............	610	1200	2225	2300	1475
Air-fuel ratio..............	12.73	14.75	16.15	17.43	18.01
Emission rates, g/hr:					
CO....................	12381.0	2239.7	374.8	97.5	101.7
HC....................	246.7	55.2	32.2	34.8	22.9
NOx**.................	246.7	460.7	784.9	686.4	346.6
Exhaust temperature, F......	1182	1342	1242	1111	1027
Exhaust pressure, in H2O....	61.0	65.0	52.0	34.0	20.0

* Corrected - SAE J816b
** Corrected for humidity.

Engine........................ Ford 351-CID
Fuel.......................... 7602

Test Number.................	31	32	33	34	35
Test Date...................	3/ 8/76	3/ 8/76	3/ 8/76	3/ 8/76	3/ 8/76
Barometer, mm Hg............	743.0	743.0	743.0	743.0	743.0
Humidity, grains/lb.........	56	56	56	56	56
Temperature, F..............	86	82	82	91	103
Engine speed, rpm...........	2000	2000	2000	2400	2400
Torque, lb-ft...............	65.0	26.0	3.2	265.0	239.0
Power, bhp*.................	24.9	9.9	1.2	122.3	111.5
Fuel rate, lb/hr............	17.1	14.2	11.5	61.9	52.2
Ignition timing, deg BTC....	26.0	19.0	15.0	18.0	19.0
Manifold vacuum, in Hg......	16.0	18.5	20.0	.5	2.5
Throttle angle, deg.........	7.5	5.0	4.0	80.0	40.5
Intake man. temp., F........	154	147	151	111	126
Before Catalyst Concentrations, dry basis:					
CO, %.......................	.1108	.0868	.0772	5.5000	2.4100
CO2, %......................	11.45	11.11	10.69	10.59	12.87
O2, %.......................	4.45	5.00	5.70	.10	.50
HC, ppmC....................	263	145	81	1514	891
NOx, ppm....................	610	210	120	410	1563
Air-fuel ratio..............	18.60	19.21	20.04	12.43	14.12
Emission rates, g/hr:					
CO..........................	145.5	97.4	73.9	17514.1	7252.3
HC..........................	17.4	8.2	3.9	242.6	134.9
NOx**.......................	120.8	35.6	17.3	197.0	709.7
Oil temperature, F..........	227	227	217	252	251
Oil pressure, psi...........	55	57	57	53	53
Coolant temperature, F......	187	187	187	190	190
Exhaust temperature, F......	1180	1210	1227	1370	1458
Exhaust pressure, in H2O....	22.2	19.4	13.9	116.4	113.7
After Catalyst Concentrations, dry basis:					
CO, %.......................	.0700	.0630	.0607	5.5000	1.7400
CO2, %......................	11.43	10.90	10.55	10.95	13.53
O2, %.......................	4.47	5.30	5.80	.09	.30
HC, ppmC....................	179	97	60	1548	588
NOx, ppm....................	660	240	113	600	1463
Air-fuel ratio..............	18.67	19.60	20.22	12.49	14.32
Emission rates, g/hr:					
CO..........................	92.3	72.2	58.7	17526.5	5293.0
HC..........................	11.9	5.6	2.9	248.2	90.0
NOx**.......................	131.3	41.5	16.5	288.5	671.5
Exhaust temperature, F......	985	977	959	1236	1350
Exhaust pressure, in H2O....	15.0	11.0	8.0	94.0	88.0

* Corrected - SAE J816b
** Corrected for humidity.

Engine........................ Ford 351-CID
Fuel.......................... 7602

Test Number..................	36	37	38	39	40
Test Date....................	3/ 8/76	3/ 8/76	3/ 8/76	3/ 9/76	3/ 9/76
Barometer, mm Hg.............	743.0	743.0	743.0	748.0	748.0
Humidity, grains/lb..........	56	56	56	37	37
Temperature, F...............	104	102	100	77	75
Engine speed, rpm............	2400	2400	2400	2400	2400
Torque, lb-ft................	199.0	159.0	106.0	66.0	27.0
Power, bhp*..................	92.9	74.1	49.3	29.7	12.1
Fuel rate, lb/hr.............	42.6	35.9	26.8	20.3	15.2
Ignition timing, deg BTC.....	21.0	29.0	35.0	35.0	28.5
Manifold vacuum, in Hg.......	5.0	8.5	12.8	16.8	19.2
Throttle angle, deg..........	30.0	23.0	15.0	10.0	6.0
Intake man. temp., F.........	140	151	157	139	147
Before Catalyst Concentrations, dry basis:					
CO, %........................	.4100	.4570	.1325	.1012	.0892
CO2, %.......................	13.66	13.26	12.37	11.08	10.59
O2, %........................	1.40	1.85	3.35	5.00	5.50
HC, ppmC.....................	412	502	384	352	180
NOx, ppm.....................	2500	2500	2000	870	270
Air-fuel ratio...............	15.73	16.03	17.48	19.20	19.87
Emission rates, g/hr:					
CO...........................	1116.3	1073.3	254.3	163.2	111.8
HC...........................	56.5	59.3	37.1	28.5	11.4
NOx**........................	1027.2	886.0	579.1	195.8	47.2
Oil temperature, F...........	257	255	250	229	230
Oil pressure, psi............	53	53	55	56	57
Coolant temperature, F.......	190	190	184	184	184
Exhaust temperature, F.......	1471	1384	1291	1207	1217
Exhaust pressure, in H2O.....	97.0	74.8	49.9	30.5	22.2
After Catalyst Concentrations, dry basis:					
CO, %........................	.1557	.1769	.0748	.0677	.0677
CO2, %.......................	11.21	13.18	12.13	11.08	10.50
O2, %........................	1.53	2.25	3.70	5.00	5.80
HC, ppmC.....................	218	267	265	234	122
NOx, ppm.....................	2600	2600	2100	930	370
Air-fuel ratio...............	16.21	16.53	17.88	19.26	20.23
Emission rates, g/hr:					
CO...........................	446.9	428.6	147.0	109.5	86.4
HC...........................	31.5	32.6	26.2	19.1	7.8
NOx**........................	1126.1	950.5	622.7	209.9	65.9
Exhaust temperature, F.......	1307	1226	1114	1014	988
Exhaust pressure, in H2O.....	74.0	54.0	34.0	20.0	14.0

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* Corrected - SAE J816b.
** Corrected for humidity.

Engine........................ Ford 351-CID
Fuel.......................... 7602

Test Number..................	41	42	43	44	45
Test Date....................	3/ 9/76	3/ 9/76	3/ 9/76	3/ 9/76	3/ 9/76
Barometer, mm Hg............	748.0	748.0	748.0	748.0	748.0
Humidity, grains/lb.........	37	37	37	37	37
Temperature, F..............	80	90	105	94	92
Engine speed, rpm...........	2400	2800	2800	2800	2800
Torque, lb-ft...............	2.8	262.0	236.0	197.0	157.0
Power, bhp*.................	1.3	139.4	127.2	105.2	83.7
Fuel rate, lb/hr............	13.8	73.8	65.9	52.3	45.4
Ignition timing, deg BTC....	20.5	22.0	23.0	27.5	31.5
Manifold vacuum, in Hg......	20.5	.5	2.5	6.0	9.2
Throttle angle, deg.........	4.5	80.0	46.0	32.0	25.0
Intake man. temp., F........	152	104	122	120	130
Before Catalyst					
Concentrations, dry basis:					
CO, %..................	.0748	5.5000	3.6800	1.3900	1.7000
CO2, %.................	10.14	10.50	11.78	13.00	12.50
O2, %..................	6.20	.10	.40	.80	1.00
HC, ppmC...............	84	1541	1088	601	462
NOx, ppm...............	135	500	1200	2000	1625
Air-fuel ratio..............	20.79	12.42	13.45	14.80	14.79
Emission rates, g/hr:					
CO.....................	89.0	20904.7	13390.6	4400.9	4677.0
HC.....................	5.0	294.8	199.3	95.7	64.0
NOx**..................	22.4	265.1	609.2	883.5	623.7
Oil temperature, F..........	225	240	274	264	264
Oil pressure, psi...........	58	55	53	53	53
Coolant temperature, F......	187	191	192	192	191
Exhaust temperature, F......	1256	1412	1471	1504	1471
Exhaust pressure, in H2O....	19.4	160.8	158.0	130.3	102.6
After Catalyst					
Concentrations, dry basis:					
CO, %..................	.0607	5.5000	3.0300	.6725	.6425
CO2, %.................	9.99	10.79	12.25	13.53	13.53
O2, %..................	6.40	.10	.20	.45	.55
HC, ppmC...............	54	1517	803	229	143
NOx, ppm...............	143	680	1175	1450	1300
Air-fuel ratio..............	21.10	12.47	13.64	14.92	15.01
Emission rates, g/hr:					
CO.....................	73.4	20932.6	11154.7	2143.8	1786.1
HC.....................	3.3	290.5	148.7	36.7	20.0
NOx**..................	24.0	361.1	603.5	644.9	504.2
Exhaust temperature, F......	1000	1287	1365	1426	1438
Exhaust pressure, in H2O....	12.0	140.0	138.0	105.0	80.0

* Corrected - SAE 816b
** Corrected for humidity.

Engine........................ Ford 351-CID
Fuel.......................... 7602

Test Number.................	46	47	48	49	50
Test Date...................	3/ 9/76	3/ 9/76	3/ 9/76	3/ 9/76	3/ 9/76
Barometer, mm Hg............	748.0	748.0	748.0	748.0	748.0
Humidity, grains/lb.........	37	37	37	37	37
Temperature, F..............	92	81	82	75	81
Engine speed, rpm...........	2800	2800	2800	2800	3300
Torque, lb-ft...............	104.0	66.0	26.0	2.0	250.0
Power, bhp*.................	55.4	34.8	13.7	1.0	155.4
Fuel rate, lb/hr............	32.6	25.2	18.8	16.0	82.9
Ignition timing, deg BTC....	38.0	40.5	36.0	30.0	25.5
Manifold vacuum, in Hg......	14.0	16.5	19.5	21.0	1.0
Throttle angle, deg.........	17.0	12.0	8.5	6.5	80.0
Intake man. temp., F........	135	137	142	141	97
Before Catalyst					
Concentrations, dry basis:					
CO, %......................	.7325	.4362	.1013	.1340	5.5000
CO2, %.....................	12.25	11.55	10.50	10.29	10.69
O2, %......................	2.20	3.55	5.40	6.10	.10
HC, ppmC...................	238	191	144	66	1544
NOx, ppm...................	1825	1175	475	160	600
Air-fuel ratio..............	16.23	17.58	19.83	20.55	12.45
Emission rates, g/hr:					
CO.........................	1590.9	795.9	156.4	182.3	23493.1
HC.........................	26.0	17.5	11.2	4.6	331.9
NOx**......................	553.0	299.1	102.3	30.4	357.6
Oil temperature, F..........	252	247	231	234	262
Oil pressure, psi...........	55	56	57	58	53
Coolant temperature, F......	190	191	190	181	191
Exhaust temperature, F......	1410	1335	1287	1310	1492
Exhaust pressure, in H2O....	63.8	44.4	30.5	27.7	207.9
After Catalyst					
Concentrations, dry basis:					
CO, %......................	.7160	.1449	.0675	.0562	4.8900
CO2, %.....................	12.25	11.55	10.32	9.89	10.69
O2, %......................	2.60	3.65	5.60	6.20	.10
HC, ppmC...................	91	67	66	33	1340
NOx, ppm...................	1925	1250	1100	200	820
Air-fuel ratio..............	16.56	17.92	20.18	20.98	12.67
Emission rates, g/hr:					
CO.........................	1585.5	269.7	106.2	78.3	21284.9
HC.........................	10.1	6.3	5.3	2.3	293.6
NOx**......................	594.7	324.6	241.5	38.9	498.0
Exhaust temperature, F......	1287	1156	1070	1072	1367
Exhaust pressure, in H2O....	45.0	30.0	20.0	18.0	0.0

* Corrected - SAE 816b
** Corrected for humidity.

Engine........................ Ford 351-CID
Fuel.......................... 7602

Test Number.................	51	52	53	54	55
Test Date...................	3/ 9/76	3/ 9/76	3/ 9/76	3/ 9/76	3/ 9/76
Barometer, mm Hg............	748.0	748.0	748.0	748.0	748.0
Humidity, grains/lb.........	37	37	37	37	37
Temperature, F..............	87	95	77	91	92
Engine speed, rpm...........	3300	3300	3300	3300	3300
Torque, lb-ft...............	225.0	188.0	150.0	100.0	63.0
Power, bhp*.................	140.7	118.4	92.9	62.7	39.6
Fuel rate, lb/hr............	75.3	58.6	51.1	39.0	30.3
Ignition timing, deg BTC....	25.5	30.0	35.5	42.5	45.5
Manifold vacuum, in Hg......	3.0	6.0	9.5	13.2	16.0
Throttle angle, deg.........	48.0	36.0	28.0	21.0	16.0
Intake man. temp., F........	112	129	115	134	142
Before Catalyst					
Concentrations, dry basis:					
CO, %...................	4.3700	1.2700	1.7700	.8900	.2635
CO2, %..................	11.21	12.87	12.50	12.37	11.89
O2, %...................	.20	.65	.70	1.60	3.00
HC, ppmC................	1372	503	514	284	225
NOx, ppm................	1000	2250	1675	1625	1425
Air-fuel ratio..............	12.98	14.78	14.55	15.66	17.20
Emission rates, g/hr:					
CO......................	17636.9	4500.9	5398.5	2232.8	566.0
HC......................	278.7	89.7	78.9	35.8	24.3
NOx**...................	563.1	1112.5	712.8	568.8	427.1
Oil temperature, F..........	280	278	257	266	262
Oil pressure, psi...........	52	53	56	55	55
Coolant temperature, F......	191	192	190	190	189
Exhaust temperature, F......	1526	1570	1514	1487	1418
Exhaust pressure, in H2O....	196.8	163.5	119.2	83.2	61.0
After Catalyst					
Concentrations, dry basis:					
CO, %...................	3.8600	1.0800	.5584	.1650	.0630
CO2, %..................	11.66	13.40	13.53	12.92	11.66
O2, %...................	.15	.25	.43	1.55	3.50
HC, ppmC................	1088	241	177	51	73
NOx, ppm................	1125	1850	1400	1750	1475
Air-fuel ratio..............	13.21	14.61	14.97	16.04	17.84
Emission rates, g/hr:					
CO......................	15807.7	3773.4	1744.5	423.0	140.6
HC......................	224.3	42.3	27.9	6.6	8.2
NOx**...................	642.8	901.8	610.2	625.9	459.1
Exhaust temperature, F......	1407	1470	1445	1371	1240
Exhaust pressure, in H2O....	0.0	138.0	95.0	62.0	42.0

* Corrected - SAE 816b
** Corrected for humidity.

Engine........................ Ford 351-CID
Fuel.......................... 7602

Test Number..................	56	57	58	59	60
Test Date....................	3/ 9/76	3/ 9/76	3/10/76	3/10/76	3/10/76
Barometer, mm Hg............	748.0	748.0	745.1	745.1	745.1
Humidity, grains/lb.........	37	37	46	46	46
Temperature, F..............	87	83	96	96	107
Engine speed, rpm...........	3300	3300	3800	3800	3800
Torque, lb-ft...............	25.0	4.0	220.0	198.0	165.0
Power, bhp*.................	15.6	2.5	160.6	144.6	121.7
Fuel rate, lb/hr............	23.6	19.1	90.4	80.0	63.6
Ignition timing, deg BTC....	42.5	41.0	29.0	29.5	35.5
Manifold vacuum, in Hg......	19.0	20.5	1.5	3.8	6.5
Throttle angle, deg.........	11.0	9.0	80.0	45.5	36.5
Intake man. temp., F........	144	165	107	121	134
Before Catalyst					
Concentrations, dry basis:					
CO, %.......................	.1090	.1420	5.5000	4.2790	1.5750
CO2, %......................	13.25	10.50	11.32	12.02	13.67
O2, %.......................	4.60	5.10	.08	.13	.55
HC, ppmC....................	216	167	1496	1324	634
NOx, ppm....................	570	260	670	1125	2150
Air-fuel ratio..............	18.22	19.49	12.54	13.08	14.57
Emission rates, g/hr:					
CO..........................	189.9	218.9	25636.9	18331.3	5927.8
HC..........................	19.0	12.9	350.9	285.5	120.1
NOx**.......................	138.5	55.9	451.9	697.3	1170.8
Oil temperature, F..........	252	250	273	292	292
Oil pressure, psi...........	57	57	52	52	52
Coolant temperature, F......	187	187	191	191	190
Exhaust temperature, F......	1372	1331	1525	1562	1597
Exhaust pressure, in H2O....	44.4	33.3	238.4	207.9	174.6
After Catalyst					
Concentrations, dry basis:					
CO, %.......................	.0630	.0630	4.8300	3.8170	1.1000
CO2, %......................	11.00	10.50	11.66	12.50	14.35
O2, %.......................	4.50	5.10	.70	.13	.20
HC, ppmC....................	56	44	1295	1016	231
NOx, ppm....................	630	290	880	1175	1825
Air-fuel ratio..............	18.87	19.60	13.19	13.31	14.59
Emission rates, g/hr:					
CO..........................	115.9	97.7	23580.4	16588.8	4130.8
HC..........................	5.2	3.5	318.1	222.1	43.7
NOx**.......................	161.7	62.7	621.6	738.9	991.6
Exhaust temperature, F......	1152	1112	1402	1434	1494
Exhaust pressure, in H2O....	28.0	20.0	0.0	0.0	148.0

* Corrected - SAE 816b
** Corrected for humidity.

Engine........................ Ford 351-CID
Fuel.......................... 7602

Test Number.................	61	62	63	64	65
Test Date...................	3/10/76	3/10/76	3/10/76	3/10/76	3/10/76
Barometer, mm Hg............	745.1	745.1	745.1	745.1	745.1
Humidity, grains/lb.........	46	46	46	46	46
Temperature, F..............	105	99	99	85	81
Engine speed, rpm...........	3800	3800	3800	3800	3800
Torque, lb-ft...............	132.0	88.0	55.0	24.0	5.0
Power, bhp*.................	97.2	64.4	40.3	17.3	3.6
Fuel rate, lb/hr............	56.9	43.8	35.0	27.9	21.2
Ignition timing, deg BTC....	40.0	45.5	48.5	49.0	46.0
Manifold vacuum, in Hg......	9.2	13.2	16.0	19.5	20.6
Throttle angle, deg.........	31.0	23.0	17.0	12.5	9.5
Intake man. temp., F........	137	145	147	145	171
Before Catalyst Concentrations, dry basis:					
CO, %.......................	1.4961	1.6291	.7950	1.5700	.8136
CO2, %......................	13.53	13.37	13.27	12.75	11.78
O2, %.......................	.80	.93	1.75	2.35	4.75
HC, ppmC....................	455	310	106	69	90
NOx, ppm....................	2050	1175	950	490	250
Air-fuel ratio..............	14.78	14.79	15.77	15.78	18.17
Emission rates, g/hr:					
CO..........................	5107.6	4290.2	1787.6	2817.2	1282.2
HC..........................	78.1	41.1	12.0	6.2	7.2
NOx**.......................	1012.6	447.7	309.1	127.2	57.0
Oil temperature, F..........	283	285	275	257	262
Oil pressure, psi...........	52	53	54	56	55
Coolant temperature, F......	190	189	189	188	187
Exhaust temperature, F......	1582	1545	1542	1506	1397
Exhaust pressure, in H2O....	149.7	99.8	72.1	47.1	38.8
After Catalyst Concentrations, dry basis:					
CO, %.......................	.6816	.3650	.0844	.2100	.2100
CO2, %......................	14.66	14.63	13.80	13.13	12.25
O2, %.......................	.23	.40	1.65	2.10	3.15
HC, ppmC....................	104	38	15	16	32
NOx, ppm....................	1575	1125	1075	580	350
Air-fuel ratio..............	14.79	15.04	16.06	16.36	17.28
Emission rates, g/hr:					
CO..........................	2316.5	972.3	193.0	391.6	315.4
HC..........................	17.8	5.1	1.7	1.5	2.4
NOx**.......................	774.5	433.6	355.7	156.5	76.1
Exhaust temperature, F......	1515	1417	1412	1281	1175
Exhaust pressure, in H2O....	124.0	75.0	52.0	33.0	26.0

* Corrected - SAE J816b
** Corrected for humidity.

Engine........................ Ford 351-CID
Fuel.......................... 7602

Test Number..................	70	71	72	73	74
Test Date....................	5/ 4/76	5/ 4/76	5/ 4/76	5/ 4/76	5/ 4/76
Barometer, mm Hg............	749.0	749.0	749.0	749.0	749.0
Humidity, grains/lb.........	59	59	59	59	59
Temperature, F..............	77	82	86	82	82
Engine speed, rpm...........	1500	1500	1500	1500	1500
Torque, lb-ft...............	231.0	154.0	64.0	26.0	2.2
Power, bhp*.................	65.3	43.7	18.2	7.4	.6
Fuel rate, lb/hr............	25.9	20.8	11.9	9.5	9.1
Ignition timing, deg BTC....	14.0	22.0	13.0	12.0	14.5
Manifold vacuum, in Hg......	3.5	9.0	16.0	19.5	20.5
Throttle angle, deg.........	37.0	18.0	12.0	10.5	7.0
Intake man. temp., F........	112	142	156	142	141
Before Catalyst					
Concentrations, dry basis:					
CO, %...................	.2890	.0584	.1132	.1301	.1084
CO2, %..................	12.62	11.66	10.90	10.50	9.69
O2, %...................	1.80	3.30	4.60	5.00	6.00
HC, ppmC................	646	617	301	178	132
NOx, ppm................	2375	1850	305	118	70
Air-fuel ratio..............	16.13	17.61	18.89	19.41	20.81
Emission rates, g/hr:					
CO......................	495.4	88.2	105.0	100.0	85.5
HC......................	55.7	46.9	14.0	6.9	5.2
NOx**...................	621.8	426.6	43.2	13.8	8.4
Oil temperature, F..........	196	230	224	207	207
Oil pressure, psi...........	55	54	54	55	55
Coolant temperature, F......	192	190	188	187	186
Exhaust temperature, F......	901	929	882	837	864
Exhaust pressure, in H2O....	33.3	26.3	11.1	8.3	6.9
After Catalyst					
Concentrations, dry basis:					
CO, %...................	.1036	.0424	.0677	.0677	.0561
CO2, %..................	12.25	11.55	10.69	10.19	9.69
O2, %...................	2.50	3.60	4.80	5.26	6.25
HC, ppmC................	451	381	183	122	9
NOx, ppm................	2175	1600	305	125	75
Air-fuel ratio..............	16.86	17.93	19.22	19.87	21.15
Emission rates, g/hr:					
CO......................	185.9	65.2	64.0	53.4	44.9
HC......................	40.8	29.5	8.7	4.8	.4
NOx**...................	596.2	375.7	44.0	15.0	9.2
Exhaust temperature, F......	961	1012	938	821	846
Exhaust pressure, in H2O....	25.0	16.0	6.0	5.0	4.0

* Corrected - SAE J816b
** Corrected for humidity.

Engine........................ Ford 351-CID
Fuel.......................... 7602

Test Number..................	75	76	77	78	79
Test Date....................	5/ 4/76	5/ 5/76	5/ 5/76	5/ 5/76	5/ 5/76
Barometer, mm Hg............	749.0	739.0	739.0	739.0	739.0
Humidity, grains/lb.........	59	69	69	69	69
Temperature, F..............	82	92	82	84	84
Engine speed, rpm...........	2000	2000	2000	2000	2000
Torque, lb-ft...............	234.0	156.0	65.0	26.0	3.4
Power, bhp*.................	88.6	60.5	25.0	10.0	1.3
Fuel rate, lb/hr............	41.0	28.7	17.6	14.0	11.6
Ignition timing, deg BTC....	20.0	28.0	26.0	24.0	18.0
Manifold vacuum, in Hg......	4.5	9.5	16.5	18.0	21.0
Throttle angle, deg.........	35.5	19.5	7.5	6.0	5.0
Intake man. temp., F........	114	134	154	162	161
Before Catalyst					
Concentrations, dry basis:					
CO, %.................	.1150	.1036	.1132	.0844	.0820
CO2, %................	12.50	12.50	10.90	10.79	9.89
O2, %.................	1.11	2.65	5.25	5.50	6.75
HC, ppmC..............	678	520	407	256	105
NOx, ppm..............	2050	2300	535	245	95
Air-fuel ratio..............	15.70	16.93	19.46	19.77	21.47
Emission rates, g/hr:					
CO....................	304.8	206.2	160.6	96.9	85.2
HC....................	90.5	52.1	29.0	14.8	5.5
NOx**.................	831.4	732.1	121.4	45.0	15.8
Oil temperature, F..........	215	214	234	222	214
Oil pressure, psi...........	55	55	55	56	59
Coolant temperature, F......	190	189	190	188	184
Exhaust temperature, F......	1027	936	934	912	927
Exhaust pressure, in H2O....	72.0	44.3	19.4	13.9	11.1
After Catalyst					
Concentrations, dry basis:					
CO, %.................	.3390	.0515	.0724	.0561	.0538
CO2, %................	12.87	11.89	11.00	10.50	9.79
O2, %.................	1.30	3.55	5.00	5.75	6.75
HC, ppmC..............	170	326	212	105	55
NOx, ppm..............	2000	1975	525	185	100
Air-fuel ratio..............	15.75	17.82	19.27	20.20	21.58
Emission rates, g/hr:					
CO....................	897.0	108.3	101.7	65.9	56.2
HC....................	22.7	34.5	15.0	6.2	2.9
NOx**.................	809.7	663.9	117.9	34.8	16.7
Exhaust temperature, F......	1171	1024	1014	958	932
Exhaust pressure, in H2O....	54.0	31.0	12.0	9.0	7.0

* Corrected - SAE J816b
** Corrected for humidity.

Engine....................... Ford 351-CID
Fuel......................... 7602

Test Number..................	80	81	82	83	84
Test Date....................	5/ 5/76	5/ 5/76	5/ 6/76	5/ 6/76	5/ 6/76
Barometer, mm Hg............	739.0	739.0	740.7	740.7	740.7
Humidity, grains/lb.........	69	69	65	65	65
Temperature, F..............	84	85	71	81	82
Engine speed, rpm...........	2200	2200	2200	2200	2200
Torque, lb-ft...............	257.0	171.0	71.0	28.0	2.4
Power, bhp*.................	108.9	72.5	29.6	11.8	1.0
Fuel rate, lb/hr............	49.2	32.9	18.7	14.5	11.9
Ignition timing, deg BTC....	19.0	28.0	32.5	26.0	20.5
Manifold vacuum, in Hg......	2.0	8.0	16.0	19.5	21.5
Throttle angle, deg.........	35.0	22.0	9.0	6.5	5.0
Intake man. temp., F........	114	147	147	162	156
Before Catalyst Concentrations, dry basis:					
CO, %..................	1.7400	.1721	.1036	.0820	.0796
CO2, %.................	12.62	12.75	10.69	10.50	9.89
O2, %..................	.75	2.10	5.10	6.00	7.50
HC, ppmC...............	823	561	473	183	110
NOx, ppm...............	2150	2550	540	175	98
Air-fuel ratio..............	14.59	16.43	19.41	20.38	22.20
Emission rates, g/hr:					
CO.....................	5110.9	381.9	156.1	100.5	87.2
HC.....................	121.6	62.7	35.8	11.3	6.1
NOx**..................	1009.8	904.7	127.8	33.7	16.8
Oil temperature, F..........	232	242	211	226	225
Oil pressure, psi...........	55	55	57	56	56
Coolant temperature, F......	191	190	181	181	187
Exhaust temperature, F......	1074	1031	895	921	935
Exhaust pressure, in H20....	97.0	56.8	22.2	16.6	13.9
After Catalyst Concentrations, dry basis:					
CO, %..................	.9092	.0868	.0677	.0584	.0653
CO2, %.................	13.26	12.13	11.11	10.39	9.89
O2, %..................	.60	3.00	5.00	6.50	7.50
HC, ppmC...............	355	338	324	139	69
NOx, ppm...............	2050	2450	500	188	108
Air-fuel ratio..............	14.92	17.31	19.21	20.95	22.23
Emission rates, g/hr:					
CO.....................	2725.2	203.6	100.6	73.5	71.6
HC.....................	53.5	39.9	24.2	8.8	3.8
NOx**..................	982.5	918.8	116.8	37.1	18.5
Exhaust temperature, F......	1279	1131	954	956	942
Exhaust pressure, in H20....	75.0	42.0	15.0	11.0	8.0

* Corrected - SAE J816b
** Corrected for humidity.

Engine...................... Ford 351-CID
Fuel........................ 7602

Test Number.................	85	86	87	88	89
Test Date...................	5/ 6/76	5/ 6/76	5/ 6/76	5/ 6/76	5/ 6/76
Barometer, mm Hg............	740.7	740.7	740.7	740.7	740.7
Humidity, grains/lb.........	65	65	65	65	65
Temperature, F..............	81	82	81	81	81
Engine speed, rpm...........	2400	2400	2400	2400	2400
Torque, lb-ft...............	239.0	159.0	66.0	27.0	2.8
Power, bhp*.................	109.8	73.1	30.3	12.4	1.3
Fuel rate, lb/hr............	51.1	36.1	22.3	15.6	15.7
Ignition timing, deg BTC....	20.0	29.5	37.0	30.0	29.0
Manifold vacuum, in Hg......	4.0	9.0	15.0	19.0	21.0
Throttle angle, deg.........	40.5	23.0	10.0	6.5	5.0
Intake man. temp., F........	117	151	172	181	166
Before Catalyst					
Concentrations, dry basis:					
CO, %.................	2.4100	.4570	.1012	.0892	.0748
CO2, %................	12.87	13.20	11.08	10.59	10.14
O2, %.................	.93	1.75	4.35	5.75	6.40
HC, ppmC..............	701	445	324	219	100
NOx, ppm..............	1575	2260	785	175	95
Air-fuel ratio..............	14.41	15.97	18.64	20.09	20.98
Emission rates, g/hr:					
CO....................	7226.3	1074.1	174.2	115.8	101.9
HC....................	105.8	52.6	28.0	14.3	6.8
NOx**.................	742.1	834.7	212.4	35.7	20.3
Oil temperature, F..........	235	251	230	234	226
Oil pressure, psi...........	55	54	56	56	59
Coolant temperature, F......	191	189	188	187	187
Exhaust temperature, F......	1079	1061	934	958	977
Exhaust pressure, in H2O....	110.8	63.7	30.5	19.4	19.4
After Catalyst					
Concentrations, dry basis:					
CO, %.................	1.7400	.1769	.0677	.0677	.0607
CO2, %................	13.53	13.18	11.08	10.50	9.99
O2, %.................	.70	2.50	4.60	6.00	6.50
HC, ppmC..............	277	256	262	133	88
NOx, ppm..............	1800	2240	820	237	98
Air-fuel ratio..............	14.61	16.70	18.90	20.41	21.19
Emission rates, g/hr:					
CO....................	5274.1	434.6	118.1	89.3	83.6
HC....................	42.2	31.7	23.0	8.8	6.1
NOx**.................	857.4	864.8	224.9	49.1	21.1
Exhaust temperature, F......	1271	1187	981	970	967
Exhaust pressure, in H2O....	85.0	46.0	20.0	12.0	11.0

* Corrected - SAE J816b
** Corrected for humidity.

Engine........................ Ford 351-CID
Fuel.......................... 7602

Test Number..................	90	91	92	93	94
Test Date....................	5/ 7/76	5/ 7/76	5/ 7/76	5/ 7/76	5/ 7/76
Barometer, mm Hg............	751.0	751.0	751.0	751.0	751.0
Humidity, grains/lb.........	54	54	54	54	54
Temperature, F..............	77	85	84	82	84
Engine speed, rpm...........	2800	2800	2800	2800	2800
Torque, lb-ft...............	236.0	157.0	66.0	26.0	1.2
Power, bhp*.................	124.0	83.1	34.9	13.7	.6
Fuel rate, lb/hr............	59.6	41.9	24.2	18.3	15.3
Ignition timing, deg BTC....	25.0	33.5	42.0	39.0	33.0
Manifold vacuum, in Hg......	4.5	9.0	16.0	19.0	20.0
Throttle angle, deg.........	46.0	25.0	12.0	8.5	6.5
Intake man. temp., F........	106	149	174	177	177
Before Catalyst					
Concentrations, dry basis:					
CO, %.....................	1.9300	1.3400	.0796	.0700	.0748
CO2, %....................	12.37	12.37	11.21	10.19	9.59
O2, %.....................	.42	1.20	4.40	5.75	7.00
HC, ppmC..................	594	432	251	199	132
NOx, ppm..................	1525	1600	700	217	103
Air-fuel ratio..............	14.27	15.11	18.67	20.32	21.93
Emission rates, g/hr:					
CO........................	6738.9	3481.0	148.8	108.2	104.7
HC........................	104.3	56.5	23.6	15.5	9.3
NOx**.....................	797.8	622.8	196.1	50.2	21.5
Oil temperature, F..........	226	262	254	237	236
Oil pressure, psi...........	56	54	55	57	56
Coolant temperature, F......	191	191	189	187	184
Exhaust temperature, F......	1112	1121	1016	996	996
Exhaust pressure, in H2O....	135.7	88.6	38.8	24.9	24.9
After Catalyst					
Concentrations, dry basis:					
CO, %.....................	2.0300	.4608	.0538	.0515	.0515
CO2, %....................	12.75	12.87	11.00	10.09	9.59
O2, %.....................	.40	1.25	4.50	5.75	7.00
HC, ppmC..................	458	142	150	111	77
NOx, ppm..................	1275	1650	900	255	123
Air-fuel ratio..............	14.24	15.64	18.88	20.42	21.97
Emission rates, g/hr:					
CO........................	7043.8	1236.6	101.9	80.0	72.3
HC........................	80.0	19.2	14.3	8.6	5.4
NOx**.....................	662.9	663.4	255.3	59.4	25.8
Exhaust temperature, F......	1351	1342	1081	1014	1004
Exhaust pressure, in H2O....	110.0	70.0	28.0	16.0	14.0

* Corrected - SAE J816b
** Corrected for humidity.

Engine........................ Ford 351-CID
Fuel.......................... 7602

Test Number..................	95	96	97	98	99
Test Date....................	5/ 7/76	5/ 7/76	5/ 7/76	5/ 7/76	5/ 7/76
Barometer, mm Hg............	751.0	751.0	751.0	751.0	751.0
Humidity, grains/lb.........	64	64	64	64	64
Temperature, F..............	88	81	87	86	78
Engine speed, rpm...........	3300	3300	3300	3300	3300
Torque, lb-ft...............	225.0	150.0	63.0	25.0	4.2
Power, bhp*.................	141.1	93.5	39.5	15.7	2.6
Fuel rate, lb/hr............	72.8	49.8	27.6	27.0	19.3
Ignition timing, deg BTC....	29.0	37.0	48.0	46.0	43.0
Manifold vacuum, in Hg......	3.5	9.5	16.0	18.5	19.5
Throttle angle, deg.........	48.0	28.0	16.0	11.0	9.0
Intake man. temp., F........	110	121	167	178	144
Before Catalyst					
Concentrations, dry basis:					
CO, %..................	3.4600	.9900	.0844	.1180	.0892
CO2, %.................	1189.00	12.50	11.00	11.21	9.79
O2, %..................	1.00	1.20	4.20	5.00	6.00
HC, ppmC...............	11381	426	290	235	132
NOx, ppm...............	1250	1825	760	290	120
Air-fuel ratio..............	14.88	15.30	18.55	19.13	20.77
Emission rates, g/hr:					
CO.....................	1308.2	3094.8	178.8	251.1	148.7
HC.....................	216.6	67.1	30.9	25.1	11.1
NOx**..................	74.0	892.9	252.0	96.6	31.3
Oil temperature, F..........	276	226	265	252	207
Oil pressure, psi...........	53	58	55	57	62
Coolant temperature, F......	191	192	191	191	187
Exhaust temperature, F......	1181	1051	1061	1051	972
Exhaust pressure, in H2O....	180.1	105.3	55.4	36.0	27.7
After Catalyst					
Concentrations, dry basis:					
CO, %..................	.3546	.3390	.0515	.0515	.0700
CO2, %.................	12.13	13.00	11.00	10.29	10.09
O2, %..................	.15	1.00	4.30	5.75	5.75
HC, ppmC...............	643	250	95	720	66
NOx, ppm...............	1425	1850	935	340	150
Air-fuel ratio..............	14.81	15.51	18.71	20.20	20.40
Emission rates, g/hr:					
CO.....................	1584.0	1072.4	110.0	116.4	114.4
HC.....................	144.6	39.8	10.2	81.9	5.5
NOx**..................	996.2	915.9	312.6	120.3	38.4
Exhaust temperature, F......	1412	1212	1168	1093	986
Exhaust pressure, in H2O....	160.0	81.0	38.0	23.0	18.0

* Corrected - SAE J816b
** Corrected for humidity.

Engine........................ Ford 351-CID
Fuel.......................... 7602

Test Number..................	101	102	103	104	105
Test Date....................	5/ 7/76	5/ 7/76	5/ 7/76	5/ 7/76	3/23/76
Barometer, mm Hg.............	751.0	751.0	751.0	751.0	750.6
Humidity, grains/lb..........	64	64	64	64	42
Temperature, F...............	89	91	90	86	84
Engine speed, rpm............	3800	3800	3800	3800	700
Torque, lb-ft................	150.0	63.0	25.0	3.4	0.0
Power, bhp*..................	108.4	45.6	18.1	2.5	0.0
Fuel rate, lb/hr.............	52.4	45.9	26.6	22.0	4.7
Ignition timing, deg BTC.....	42.0	49.0	52.0	50.0	6.0
Manifold vacuum, in Hg.......	7.5	15.0	17.0	20.0	17.5
Throttle angle, deg..........	34.0	19.0	12.5	9.5	0.0
Intake man. temp., F.........	145	171	178	195	136
Before Catalyst					
Concentrations, dry basis:					
CO, %..................	1.2700	.7950	.1744	.1642	.5416
CO2, %.................	12.37	12.35	11.11	11.03	10.50
O2, %..................	1.00	1.70	4.00	4.80	6.50
HC, ppmC...............	364	204	223	558	37
NOx, ppm...............	1800	1387	490	192	1250
Air-fuel ratio...............	15.02	15.79	18.26	18.92	20.40
Emission rates, g/hr:					
CO.....................	4103.5	2365.5	351.0	282.3	212.6
HC.....................	59.2	30.6	22.6	48.3	.7
NOx**..................	910.2	645.9	154.4	51.7	69.6
Oil temperature, F...........	291	284	272	261	202
Oil pressure, psi............	50	54	55	56	35
Coolant temperature, F.......	191	192	189	189	190
Exhaust temperature, F.......	1214	1134	1112	1084	872
Exhaust pressure, in H2O.....	138.5	69.3	54.0	33.2	2.8
After Catalyst					
Concentrations, dry basis:					
CO, %..................	.3040	.1420	.0772	.1180	.2571
CO2, %.................	13.00	12.62	11.11	10.69	10.50
O2, %..................	.90	1.60	4.20	4.70	6.50
HC, ppmC...............	51	20	558	834	48
NOx, ppm...............	1800	1450	510	197	1250
Air-fuel ratio...............	15.47	16.11	18.47	18.96	20.72
Emission rates, g/hr:					
CO.....................	1010.0	431.1	157.2	203.9	102.6
HC.....................	8.6	3.0	57.2	72.5	1.0
NOx**..................	935.9	689.0	162.5	53.3	70.8
Exhaust temperature, F.......	1478	1285	1205	1154	661
Exhaust pressure, in H2O.....	110.0	50.0	31.0	23.0	2.0

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* Corrected - SAE J816b
** Corrected for humidity.

Engine........................ Ford 351-CID
Fuel.......................... 7602

Test Number..................	106	107	108	109
Test Date....................	3/23/76	3/23/76	4/ 5/76	4/ 5/76
Barometer, mm Hg.............	750.6	750.6	744.0	744.0
Humidity, grains/lb..........	42	42	66	66
Temperature, F...............	81	80	95	84
Engine speed, rpm............	700	700	4000	2200
Torque, lb-ft................	8.0	15.0	203.5	271.0
Power, bhp*..................	1.1	2.0	163.8	114.0
Fuel rate, lb/hr.............	5.0	5.0	90.2	55.6
Ignition timing, deg BTC....	6.0	6.0	31.0	20.0
Manifold vacuum, in Hg......	17.0	16.5	2.0	1.0
Throttle angle, deg.........	.5	.5	80.0	80.0
Intake man. temp., F........	136	136	114	110
Before Catalyst				
Concentrations, dry basis:				
CO, %..................	.5584	.5754	4.9400	4.6200
CO2, %.................	10.59	10.29	10.90	11.66
O2, %..................	6.25	6.25	.20	.10
HC, ppmC...............	41	37	1315	1494
NOx, ppm...............	800	1000	975	810
Air-fuel ratio..............	20.09	20.23	12.75	12.88
Emission rates, g/hr:				
CO.....................	233.6	238.7	23488.8	13585.6
HC.....................	.9	.8	314.6	221.2
NOx**..................	47.5	58.9	731.5	375.8
Oil temperature, F..........	191	204	305	254
Oil pressure, psi...........	40	36	50	52
Coolant temperature, F......	185	176	191	190
Exhaust temperature, F......	820	892	1546	1345
Exhaust pressure, in H2O....	5.5	5.5	249.5	99.8
After Catalyst				
Concentrations, dry basis:				
CO, %..................	.3156	.3301	4.4200	4.1300
CO2, %.................	10.50	10.29	11.32	12.01
O2, %..................	6.35	6.55	.20	.10
HC, ppmC...............	49	40	1088	1438
NOx, ppm...............	550	530	1425	1125
Air-fuel ratio..............	20.48	20.76	13.02	13.10
Emission rates, g/hr:				
CO.....................	134.8	140.6	21389.1	12325.2
HC.....................	1.1	.9	264.9	216.0
NOx**..................	33.3	32.0	1088.1	529.7
Exhaust temperature, F......	595	682	1416	1207
Exhaust pressure, in H2O....	2.0	2.0	190.0	77.0

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** Corrected for humidity.

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